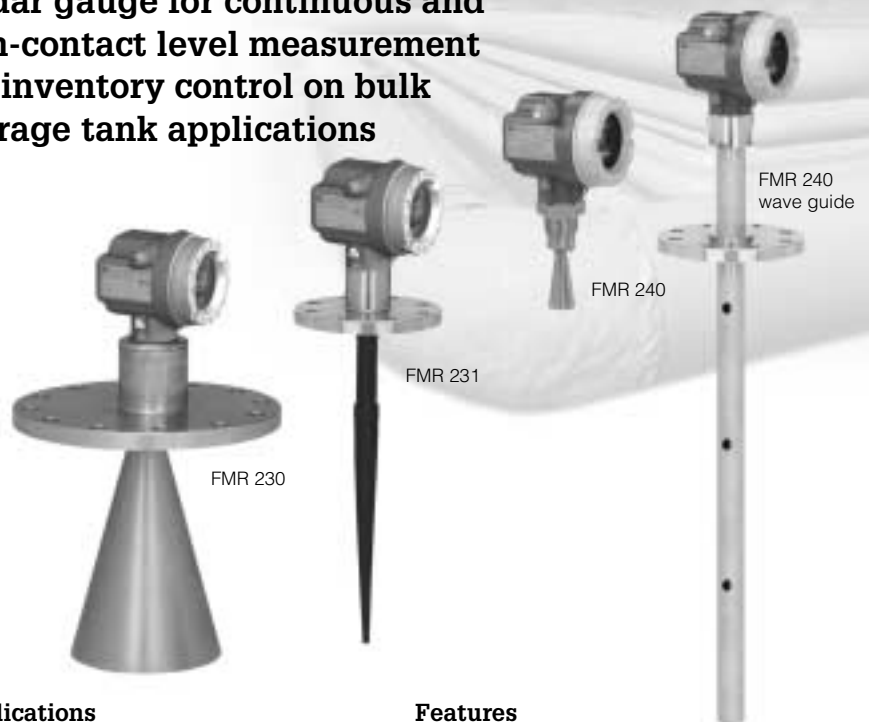


Level-Radar *micropilot M* **FMR 230/231/240**

Radar gauge for continuous and non-contact level measurement for inventory control on bulk storage tank applications



Applications

The Micropilot M is used for continuous, non-contact level measurement of liquids in bulk storage tanks for inventory control applications. Measurement is not affected by changing products, temperature changes, gas blankets or vapors.

- The FMR 230 radar with horn antenna is especially suited for measurement in bulk storage, buffer and process tanks.
- The FMR 231 radar with rod antenna has its strengths wherever high chemical compatibility is required.
- The FMR 240 wave guide, with its own integrated 1½" (38 mm) stilling well, is optimal for bullet tanks and small containers.

Features

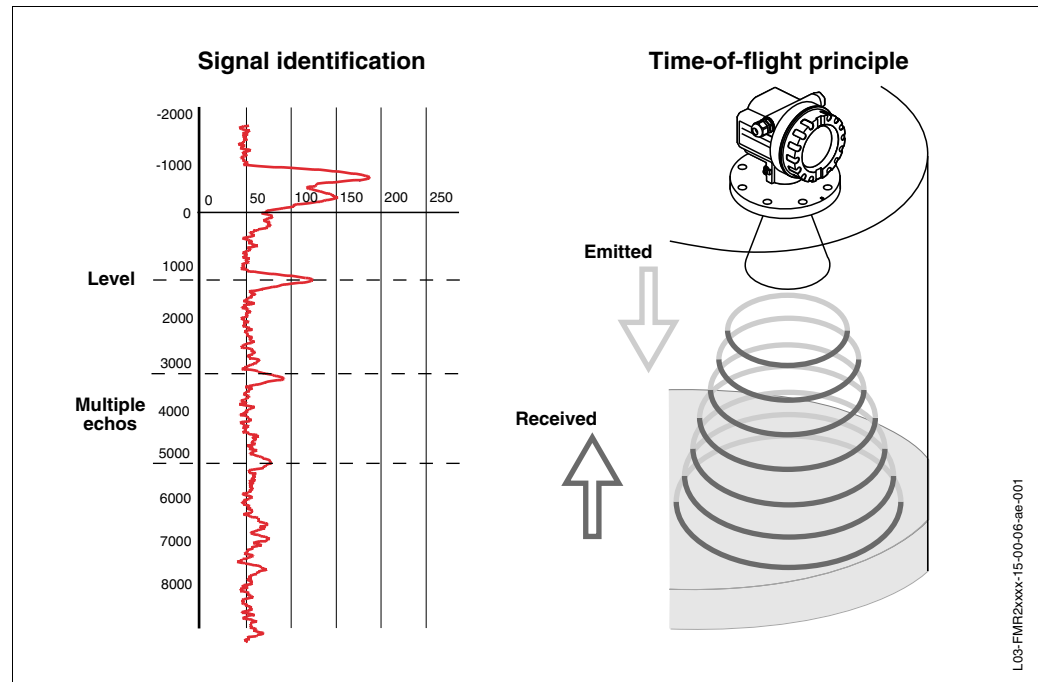
- Two-wire technology for integration with all tank sensors via the Tank Side Monitor NRF 590
- Intrinsically safe wiring for all on-tank sensors reduces wiring costs and improves reliability
- Non-contact measurement: No moving parts, no product contact and extremely low maintenance. Independent measurement not influenced by sticky or viscous products
- Easy on-tank operation via menu-driven alphanumeric display
- Easy commissioning and diagnostics
- Two frequency ranges – 6 and 26 GHz: No compromises – the right frequency for every application
- Full antenna range:
 - Horn for stilling well and free space
 - Rod for free space and narrow nozzles, condensation or product build up
 - Wave guide for light products stored in small or bullet tanks
- Instrument accuracy for inventory control measurement ± 3 to ± 6 mm

Function and system design

Measuring principle

The Micropilot is a "downward-looking" measuring system, operating based on the time-of-flight principle. It measures the distance from the reference point (gauge flange) to the product surface (also known as Ullage or Outage). Radar impulses are emitted by an antenna, reflected off the product surface and received again by the radar system.

Signal identification
and time-of-flight
principle



A microprocessor evaluates impulses received and identifies the level echo caused by the reflection of the radar impulse at the product surface. The distance to the product surface is proportional to the time-of-flight of the impulse. The unambiguous signal identification is accomplished by the PulseMaster software, based on many years of experience with time-of-flight technology. The Micropilot is also equipped with functions to suppress interference echoes. The user can activate these functions. They ensure that interference echoes (i.e. from edges and weld seams) are not interpreted as level echo.

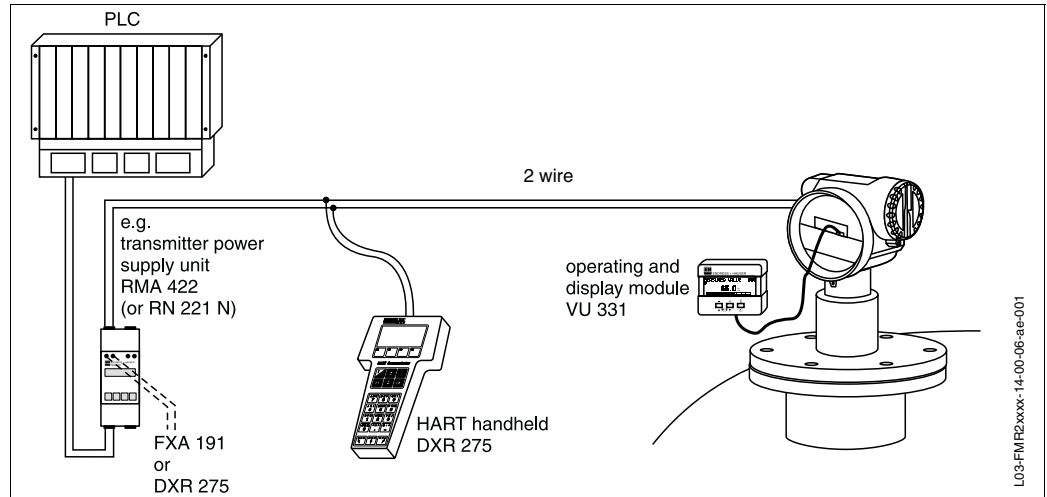
This document is dedicated to bulk storage tank gauging applications. Therefore, gauge versions and options typically required for process control have been excluded. Endress+Hauser has extensive experience in level measurement applications for process control for the food and beverage industry. Please contact Endress+Hauser for detailed advice on this and any other applications.

Equipment architecture

Standalone operation

The radar can be used as a standalone instrument, where additional tank sensors are not required or where no tank gauging system is present. The local radar display provides the operator with precise level and diagnostic information. For these applications, the radar can either be supplied intrinsically safe (i.s.) via a safety barrier or in an explosion proof (Exd) version allowing non-intrinsically safe (non-i.s.) connection. Via the same 2 wires, it is possible to connect to PLC or DCS via either 4...20 mA or using the digital HART protocol.

Typical standalone operation



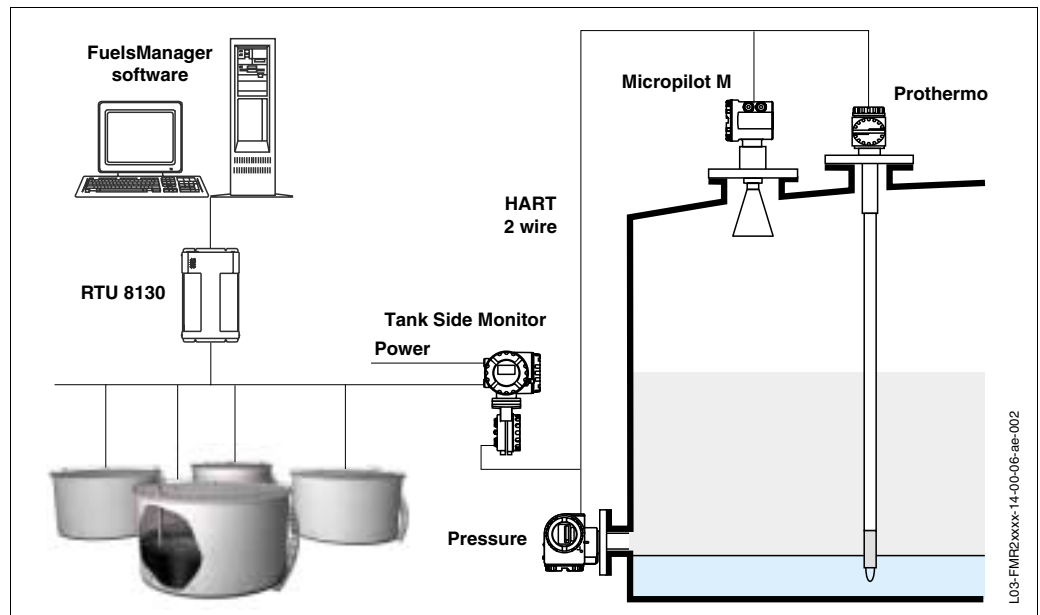
Note!

Fieldbus Foundation and Profibus are also available. Please contact your Endress+Hauser representative for more details.

Integrated on tank gauging system

The Endress+Hauser Tank Side Monitor NRF 590 provides integrated communications for sites with multiple tanks, each with one or more sensors on the tank, such as radar, spot or average temperature, capacitive probe for water detection and/or pressure sensors. Multiple protocols out of the Tank Side Monitor guarantee connectivity to nearly any of the existing industry standard tank gauging protocols. Optional connectivity of analog 4...20 mA sensors, digital I/O and analog output simplify full tank sensor integration. Use of the proven concept of the intrinsically safe HART bus for all on-tank sensors yields extremely low wiring costs, while at the same time providing maximum safety, reliability and data availability.

Typical tank gauging system



Input

Measured variable The measured variable is the distance between a reference point and a reflective surface (i.e. product surface). The product level (Innage) is calculated based on the gauge reference height entered.

Antenna selection for Micropilot M-series

It is essential for each and every application and installation to evaluate the right antenna type.

The antenna selection depends on the following criteria:

- Type of application (i.e. free space vs. stilling well)
- Installation possibilities (size, location and height of nozzle)
- Properties of the product stored in the tank (radar reflectivity, vapor pressure, temperature, etc.)
- Accuracy requirements

The Micropilot M-series radar comes with 3 basic radar antenna forms:

- Horn antenna (used for the FMR 230 and 240)
- Rod antenna (FMR 231)
- Wave guide antenna (FMR 240)

Each of these antennas has specific advantages and limitations and are hence more or less suited for the different applications and installations you might find in refineries, tank terminals, tank farms and process tanks.

Horn antenna

The horn antenna can be both utilized for free space applications, where the radar is directly installed on a nozzle on the tank roof, and stilling well applications, where the radar is installed on the stilling well. For free space applications, it is essential that the horn is bigger than 4" (DN100) and extends below the nozzle (see page 13). For stilling well applications, the diameter of the horn antenna must match the inside diameter of the stilling well. The general rule for diameter selection is "the larger, the better", as a larger aperture of the antenna generates a narrower beam and has a better gain – signal to noise (S/N) ratio. For products with a low radar reflectivity [dielectric constant (ϵ_r) < 1.9], a stilling well is always required.



There are 2 models of radar with horn antennas, the FMR 230 and FMR 240. The technical difference between these two radars is the microwave frequency on which they operate. The FMR 230 utilizes 6 GHz, while the FMR 240 uses 26 GHz. 26 GHz allows for the use of smaller aperture antennas, which have a small diameter (narrow) beam and a very good accuracy of ± 3 mm, compared to ± 10 mm for a typical 6 GHz. Both models provide sufficient level accuracy for inventory control applications. The 26 GHz is not suited for heavy foaming products, but the measuring range is slightly less than a 6 GHz FMR 230 (refer to tables on pages 6 and 7).



Rod antenna

The rod antenna is ideal for tanks where only small diameter nozzles are available and tanks containing condensing products (or heavy water condensation), as the rod is easy to clean and has good "drip-off" properties. The "inactive" length of the antenna should extend below the nozzle (see page 14).

Wave guide antenna

The wave guide antenna acts as an integrated "stilling well". As the maximum length is limited to 12.4 ft (3.8 m), this radar is best suited for horizontal bullet tanks and small tanks (containers). The small diameter [1¼" (32 mm) only] makes it possible to install 2" (51 mm) nozzles. Application should be limited to light – non-viscous or adhering – products only. The standard wave guide has only flush holes in the bottom and top. For most applications, it is suggested to specify additional flush holes [recommended: every foot (30 cm), one 3 to 5 mm diameter hole].


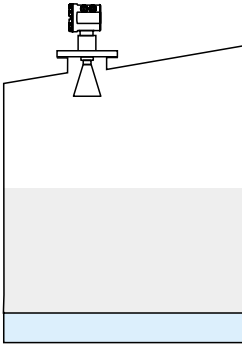
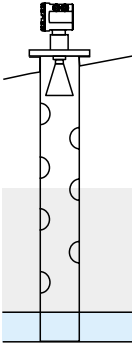

**Measuring range**

The usable measuring range depends on the size of the antenna, product properties (reflectivity of the product), the mounting location and eventual interference reflections. The following tables describe the groups of products, as well as the achievable measuring range, as a function of application and product group. If the dielectric constant (ϵ_r) of a product is unknown, it is recommended to assume product group B to ensure a reliable measurement.

Product class	ϵ_r	Examples
A	1.4 ... 1.9	non-conducting liquids, e.g. liquefied gas ¹
B	1.9 ... 4	non-conducting liquids, e.g. benzene, oil, toluene, ...
C	4 ... 10	e.g. concentrated acids, organic solvents, esters, aniline, alcohol, acetone, ...
D	> 10	conducting liquids, e.g. aqueous solutions, dilute acids and alkalis

1) Treat Ammonia NH₃ as a product of group A, i.e. always use a stilling well.

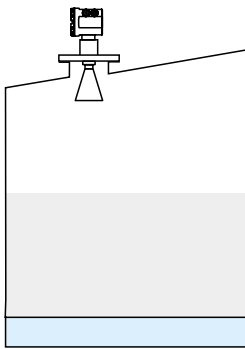
**Measuring range depending on vessel type, conditions and product for Micropilot M
FMR 230 and FMR 231:**

Product	Product class		Storage tank (scarce draining/filling)		Stilling well
	<div>FMR 230</div> <div></div>		<div></div>		<div></div>
	<div>FMR 231</div> <div></div>		<div>Measuring range</div>		<div>Measuring range</div>
	<div>FMR 230:</div>		<div>6" DN150</div>	<div>8" / 10" DN200/250</div>	<div>3"...10" DN80...250</div>
	<div>FMR 231:</div>		<div>Rod antenna</div>	<div>—</div>	<div>—</div>
LPG	A	$\epsilon_r=1.4...1.9$	On stilling well only		67 ft (20 m)
White products Black products Crudes Bitumen/Asphalts	B	$\epsilon_r=1.9...2.5$	33 ft (10 m)	50 ft (15 m)	
Chemicals	B	$\epsilon_r=2.5...4$	50 ft (15 m)	67 ft (20 m)	
	C	$\epsilon_r=4...10$			
	D	$\epsilon_r>10$	67 ft (20 m)		


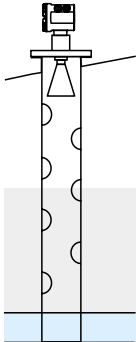
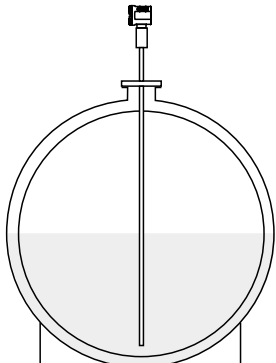

Product
considerations for
FMR 230 and 231

Note!
 ϵ_r is the dielectric constant of product.

Measuring range depending on vessel type, conditions and product for Micropilot M FMR 240:

Product	Product class	Storage tank (scarce draining/filling)			
					
		Measuring range			
		1½" (40 mm)	2" DN50	3" DN80	4" DN100
LPG	A	On stilling well only (20 m / 67 ft)			
White products Black products Crudes Bitumen/Asphalts	B	10 ft (3 m)	16 ft (5 m)	10 ft (3 m)	50 ft (15 m)
	B				
Chemicals	C	20 ft (6 m)	10 ft (3 m)	50 ft (15 m)	67 ft (20 m)
	D	30 ft (9 m)	50 ft (15 m)	67 ft (20 m)	

Product considerations for FMR 240 (horn)

Product	Product class		Stilling well	Wave guide antenna
	FMR 240 (horn) 			
	FMR 240 (wave guide) 			
	FMR 240:		Measuring range	Measuring range
			1½" (40mm) ... DN100 1½"(40mm)..4"	Wave guide antenna
LPG	A	εr=1.4...1.9	67 ft (20 m)	depending on wave guide length, max. 9.2 ft (2.8 m)
White products	B	εr=1.9...2.5		—
Black products Crudes Bitumen/Asphalts				
Chemicals				B C D

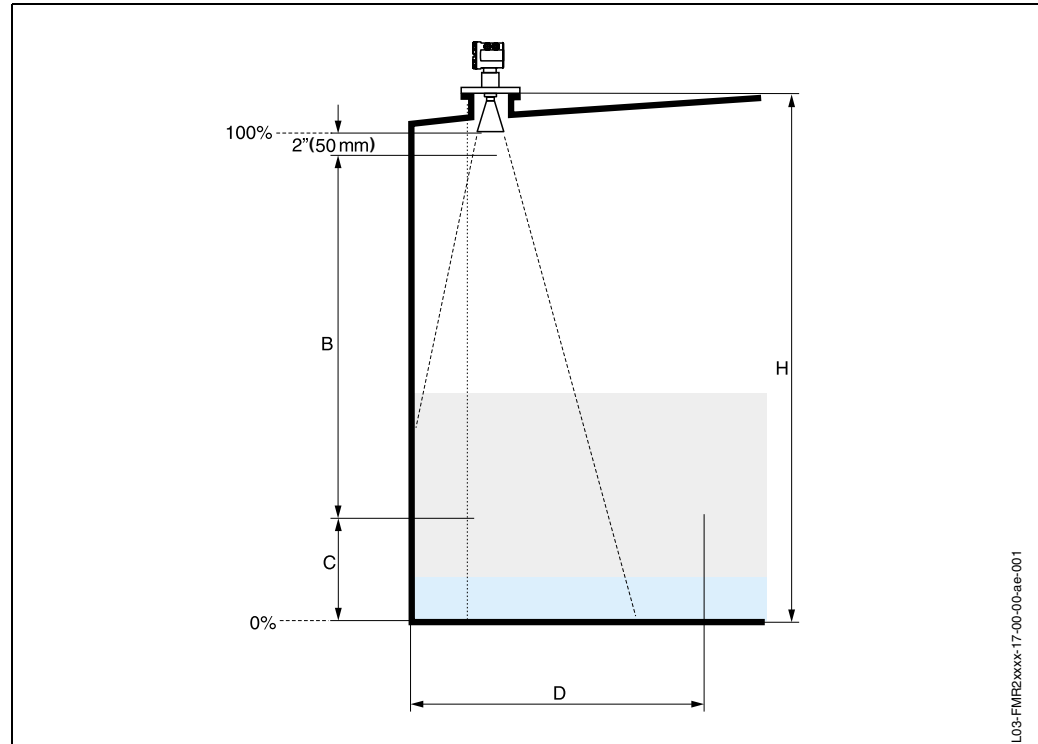
Product considerations for FMR 240 (horn) and 240 (wave guide)

Measuring conditions

Note!

- Please use FMR 230/231 for boiling surfaces or where the product has a tendency to foam.
- The maximum measuring range of the FMR 240 may decrease in case of heavy steam development, depending on density, temperature and composition of the steam (-> please use FMR 230/231).
- Please use FMR 230 in a stilling well for the measurement of ammonia NH_3 .

Illustration of
measuring conditions



	B [inch / m]	C [inch / mm]	D [inch / m]	H [ft / m]
FMR 230 / 231	> 20 / > 0.5	6...12 / 150...300	> 40 / > 1	> 5 / > 1.5
FMR 240	> 8 / > 0.2	2...6 / 50...150	> 8 / > 0.2	> 1 / > 0.3

- The measuring range begins where the radar beam hits the tank bottom. With cone shaped bottoms or sump wells, the level cannot be detected below this point.
- In case of product with a low dielectric constant (groups A and B), the tank bottom can be visible through the medium at low levels. In order to guarantee the required accuracy in these cases, it is recommended to position the zero-point at a distance **(C)** above the tank bottom.
- In principle, it is possible to measure up to the tip of the antenna. However, due to considerations regarding corrosion and build-up, the end of the measuring range should not be chosen any closer than 2" (50 mm) to the tip of the antenna.
- The smallest possible measuring range **(B)** depends on the antenna version.
- The tank diameter should be greater than **(D)**, the tank height at least **(H)**.
- Depending on consistence, microwaves can be either absorbed or reflected off the surface of foam. However, measurement is possible under certain conditions.

Output

Output signal

- All models provide a 4...20 mA output with HART protocol for connection to the Tank Side Monitor.

Signal on alarm

Error information can be accessed via the following interfaces:

- Local display:
 - Error symbol (see page 24)
 - Plain text display
- Current output
- Digital interface

Auxiliary energy

Electrical connection

Terminal compartment

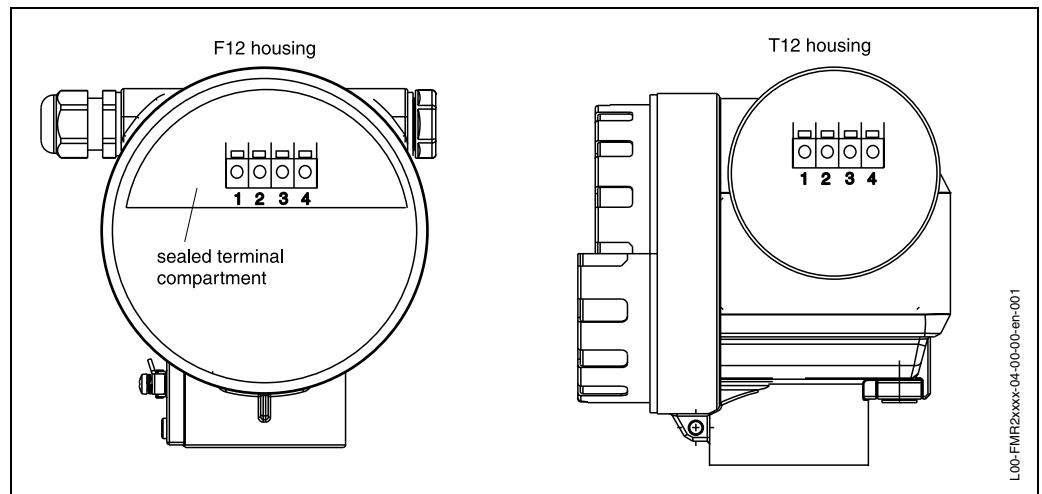
Two housings are available:

- Housing F12 with additionally sealed terminal compartment for standard or EEx ia
- Housing T12 with separate terminal compartment for standard, EEx e or EEx d

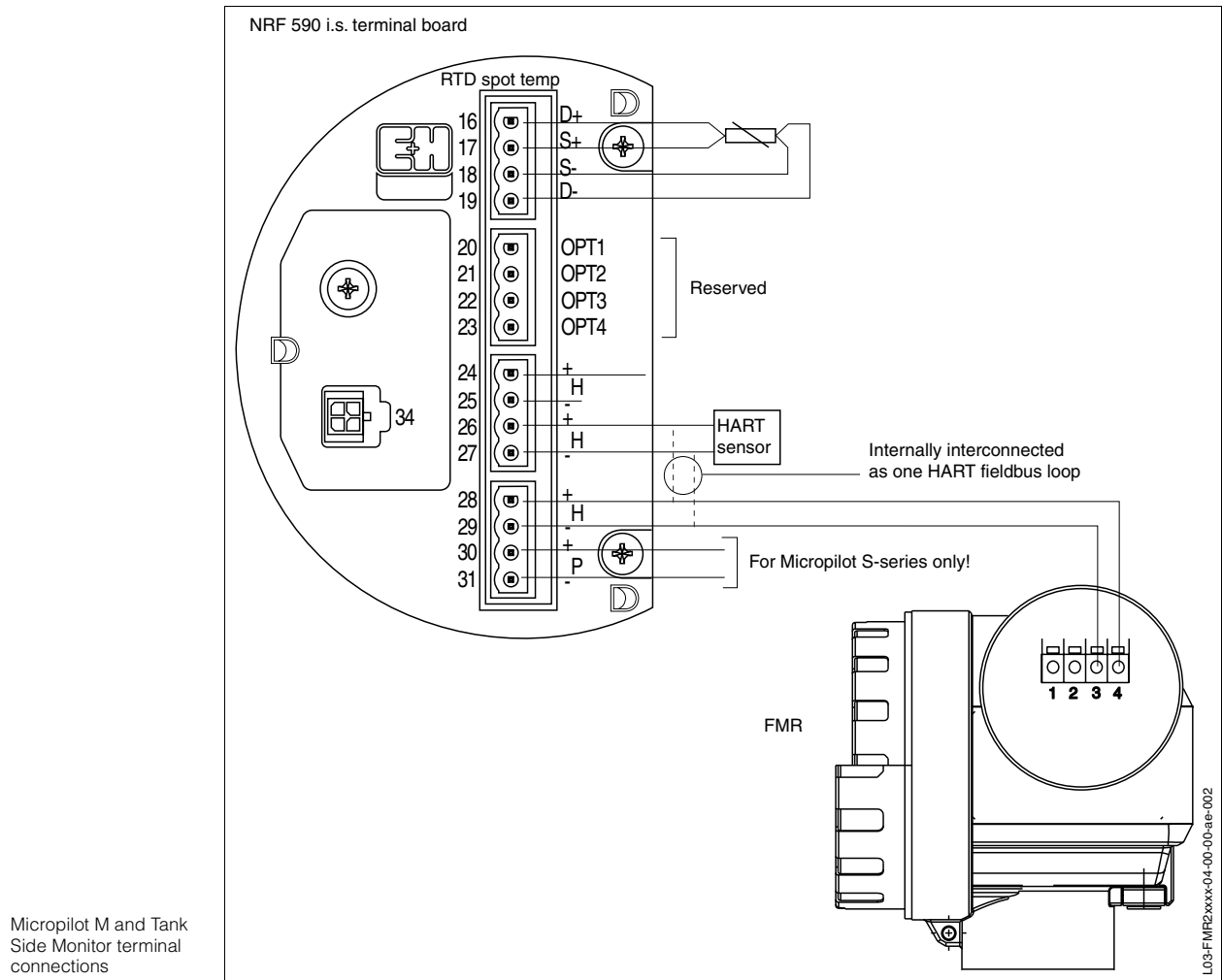
Note!

The F12 housing is ideal for installations where intrinsic safety (for example, in combination with the Tank Side Monitor NRF 590) is required. For installations where no intrinsically safe supply via a safety barrier is available or required, the T12 housing is the correct choice.

Micropilot M terminal housings



The 2-wire cable connected to the screw terminals [wire diameter 24...10 AWG (0.5...2.5 mm)] is in the terminal compartment. Use 2-wire twisted pair cable with screen for the connection. Protective circuitry against reverse polarity, RFI and over-voltage peaks is built into the device (refer to TI 241F »basics for EMC-tests«).



Load HART

Minimum load for HART communication: 250 Ω

Cable entry

Cable gland: M20x1.5 or Pg13.5
Cable entry: G 1/2 or 1/2 NPT

Supply voltage²

The following values are the voltages across the terminals directly at the instrument:

Communication		Current consumption	Terminal voltage	
			minimal	maximal
HART	standard	4 mA	16 V	36 V
		20 mA	7.5 V	36 V
	EEx ia	4 mA	16 V	30 V
		20 mA	7.5 V	30 V
	EEx em EEx d	4 mA	16 V	30 V
		20 mA	11 V	30 V
Fixed current (measured value transferred at HART)	standard	11 mA	10 V	36 V
	EEx ia	11 mA	10 V	30 V

Power consumption²

Normal operation: min. 60 mW, max. 900 mW

Current consumption²

Communication	Current consumption
HART	3.6...22 mA

2) For standalone applications.

Performance characteristics

Reference operating conditions

- Temperature = +68 °F (20 °C) ±9 °F (5 °C)
- Pressure = 14.7 psia (1013 mbar abs.) ±0.3 psi (20 mbar)
- Relative humidity (air) = 65 % ±20%
- Ideal reflector
- No major interference reflections inside the signal beam

Maximum measured error

Typical statements for reference conditions include linearity, repeatability and hysteresis:

Type of device	≤ 33 ft (10 m)	≥ 33 ft (10 m)
FMR 230	±10 mm	±0.1% of measuring range
FMR 231	±10 mm	±0.1% of measuring range
FMR 240	±3 mm	±0.03% of measuring range

Resolution

Digital / analog in % 4...20 mA

- FMR 230: 1mm / 0.1 % of measuring range
- FMR 231: 1mm / 0.1 % of measuring range
- FMR 240: 1mm / 0.1 % of measuring range

Reaction time

The reaction time depends on the parameter settings (min. 1 s). In case of fast level changes, the instrument needs the reaction time to indicate the new value.

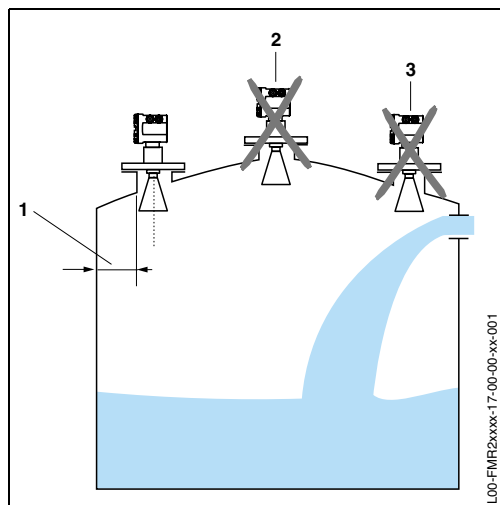
Influence of ambient temperature

0.006% / 10 K referring to maximum measuring range

Operating conditions / Installation

Installation instructions

Micropilot orientation on tank

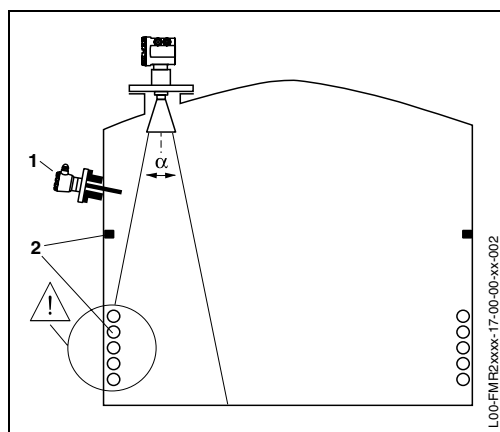


Orientation

1. Recommended distance wall – **outer edge** of nozzle: ~1/6 of tank diameter [FMR 230/231: min. 12" (30 cm), FMR 240: min. 6" (15 cm)]
2. Not in the center, radar interference can cause signal loss
3. Not above the fill stream

If required, a protection cover can be provided. Assembly and disassembly is simply done by means of a tension clamp (see »Accessories« on page 34).

Micropilot installation on tank



Tank installations

1. Avoid any installations, such as limit switches, temperature sensors, etc., inside the signal beam (refer to beam angle below).
2. Heating coils, wind rings, welds, etc., can also interfere with the measurement.

Options in order to optimize instrumentation and measurement accuracy

- Antenna size: the bigger the antenna, the smaller the beam angle, the less interference echoes.
- Mapping: the measurement can be optimized by means of electronic suppression of interference echoes.
- Antenna alignment: see "optimum mounting position" on page 13.
- Stilling well: a stilling well wave guide antenna can always be used to avoid interference.

Please contact Endress+Hauser Systems & Gauging for further information or advice.

Beam angle

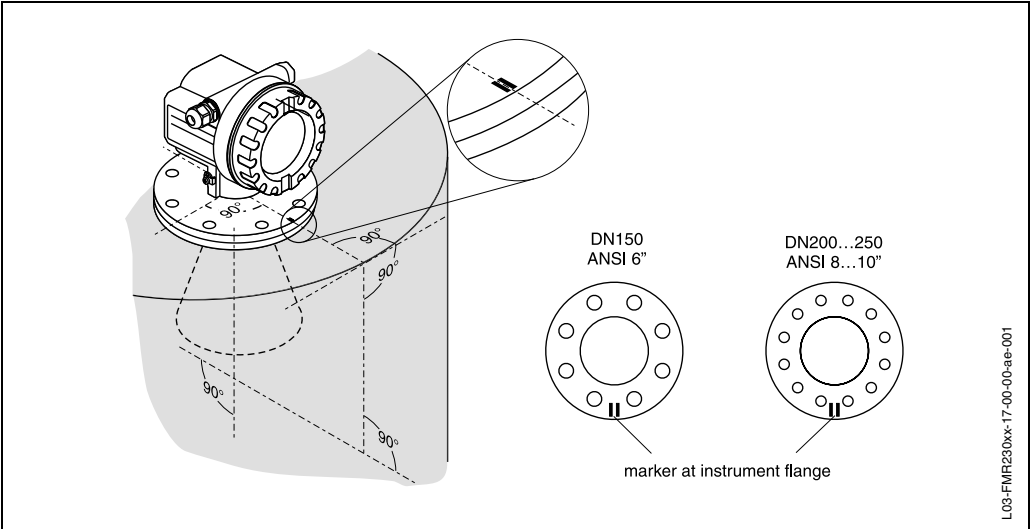
The beam angle is defined as the angle α where the energy density of the radar waves reaches half the value of the maximum energy density (3dB-width). Microwaves are also emitted outside the signal beam and can be reflected off interfering installations.

Beam angle in dependence of antenna type (diameter)

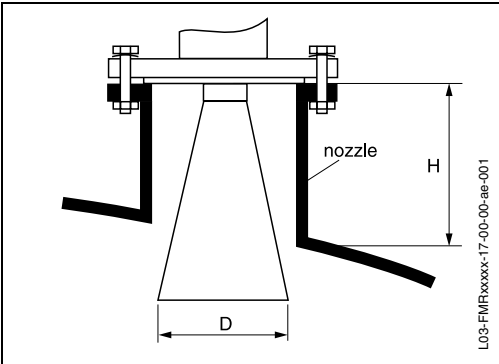
Antenna size	FMR 230			FMR 231	FMR 240			
	DN150 6"	DN200 8"	DN250 10"	Rod	1½" / 40 mm	DN50 2"	DN80 3"	DN100 4"
Beam angle α	23°	19°	15°	30°	23°	18°	10°	8°

Installation in tank
(free space) FMR 230

Optimum mounting position



FMR 230 mounted on tank

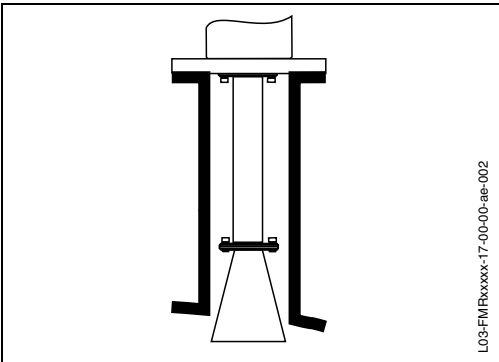


FMR 230 installation on tank

Standard installation

- Observe installation instructions on page 12.
- Marker is aligned towards tank wall.
- The marker is always exactly in the middle, between two bolt-holes in the flange.
- After mounting, the housing can be turned up to 350° in order to simplify access to the display and the terminal compartment.
- The horn antenna must extend below the nozzle, otherwise use antenna extension FAR10.
- Align horn antenna vertically.

Antenna size	6" / 150 mm	8" / 200 mm	10" / 250 mm
D [inch / mm]	5.8 / 146	7.5 / 191	9.5 / 241
H [inch / mm]	< 8.1 / < 205	< 11.5 / < 290	<15 / < 380



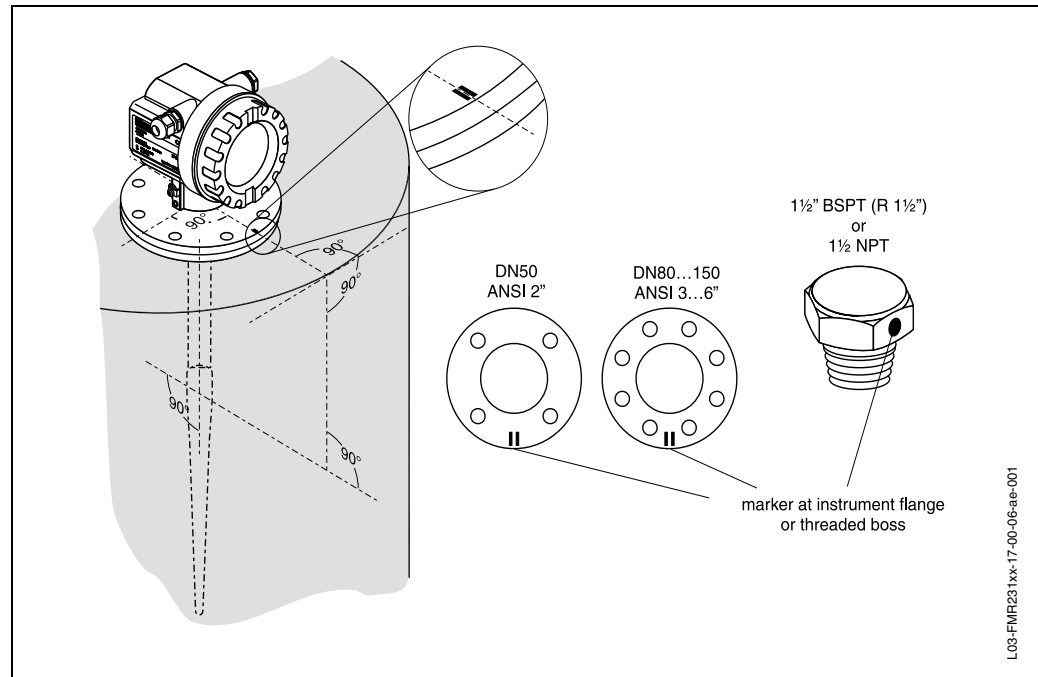
Antenna extension

Antenna extension FAR 10

- The antenna extension has to be selected such that the horn extends below the nozzle.
- If the horn diameter is greater than the nominal width of the nozzle, the antenna, including the extension, is mounted from inside the vessel. The bolts are tightened from outside, with the instrument lifted up. The extension has to be selected such that the instrument can be lifted by at least 4" (100 mm).

Installation in tank (free space) FMR 231

Optimum mounting position

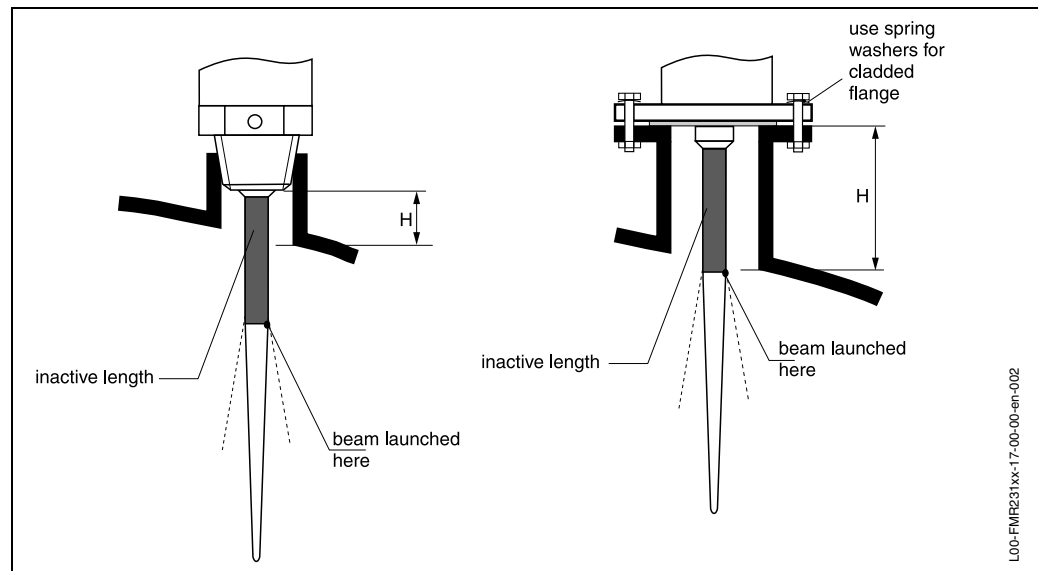


FMR 231 mounted on tank

Standard installation

- Observe installation instructions on page 12.
- Marker is aligned towards tank wall.
- The marker is always exactly in the middle, between two bolt-holes in the flange.
- After mounting, the housing can be turned up to 350° in order to simplify access to the display and the terminal compartment.
- The inactive part of the rod antenna must extend below the nozzle.
- The rod antenna must be aligned vertically.

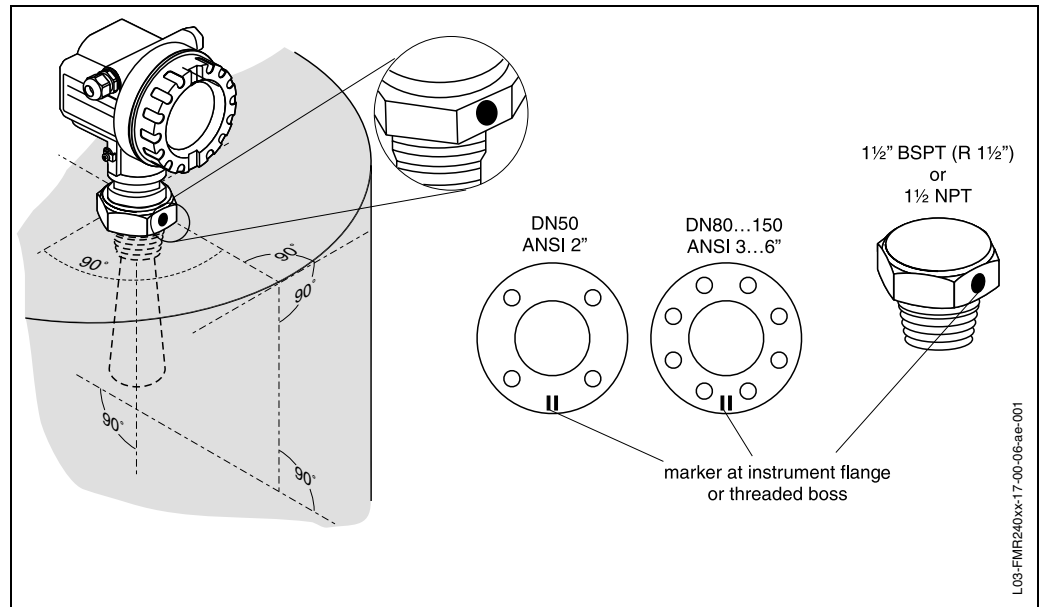
Material	PPS		PTFE	
Antenna length [inch / mm]	14 / 360	20 / 510	14 / 360	20 / 510
H [inch / mm]	< 4 / < 100	< 10 / < 250	< 4 / < 100	< 10 / < 250



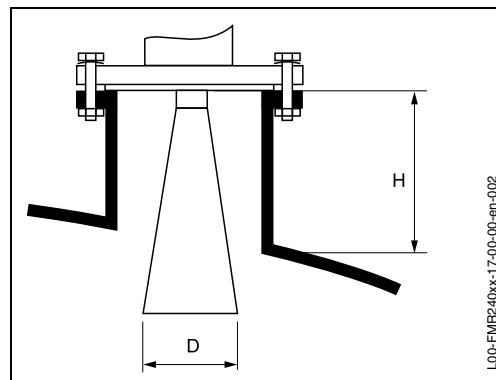
FMR 231 installation on tank

Installation in tank (free space) FMR 240

Optimum mounting position



FMR 240 mounted on
tank



FMR 240 installation
on tank

Standard installation

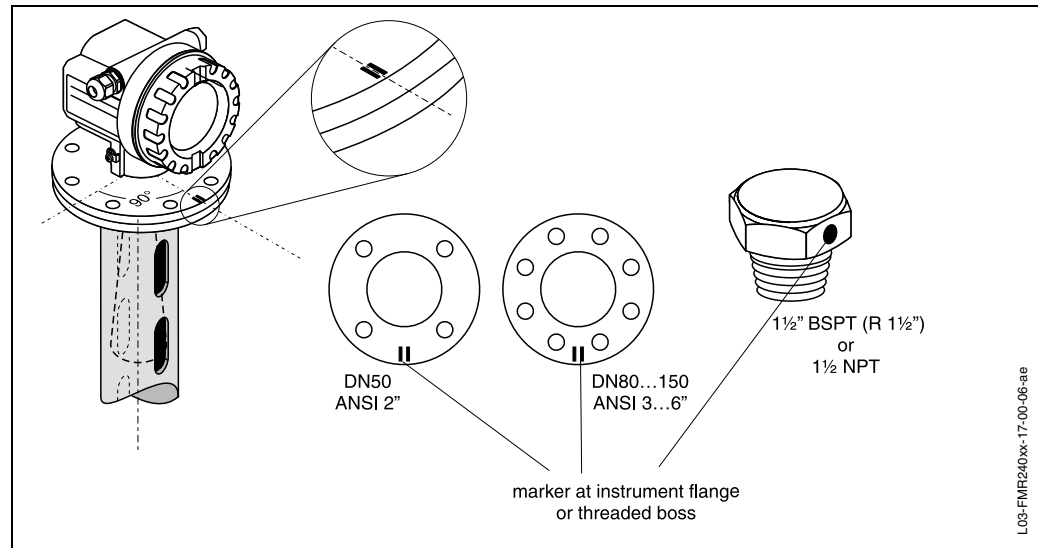
- Observe installation instructions on page 12.
- Marker is aligned towards tank wall.
- The marker is always exactly in the middle, between two bolt-holes in the flange.
- After mounting, the housing can be turned up to 350° in order to simplify access to the display and the terminal compartment.
- The horn antenna should extend below the nozzle. If required, use version with 4" (100 mm) antenna extension (see page 22).
- The horn antenna must be aligned vertically.
- The correct horn must be chosen.

Antenna size	1½" / 40 mm	DN50	DN80	DN100
D [inch / mm]	1.5 / 40	1.9 / 48	3 / 75	3.7 / 95
H [inch / mm]	< 3.4 / < 85	< 4.5 / < 115	< 8.3 / < 210	< 11 / < 280

Installation in stilling well FMR 230 / 240

Optimum mounting position

FMR 240 mounted on
stilling well



Standard installation

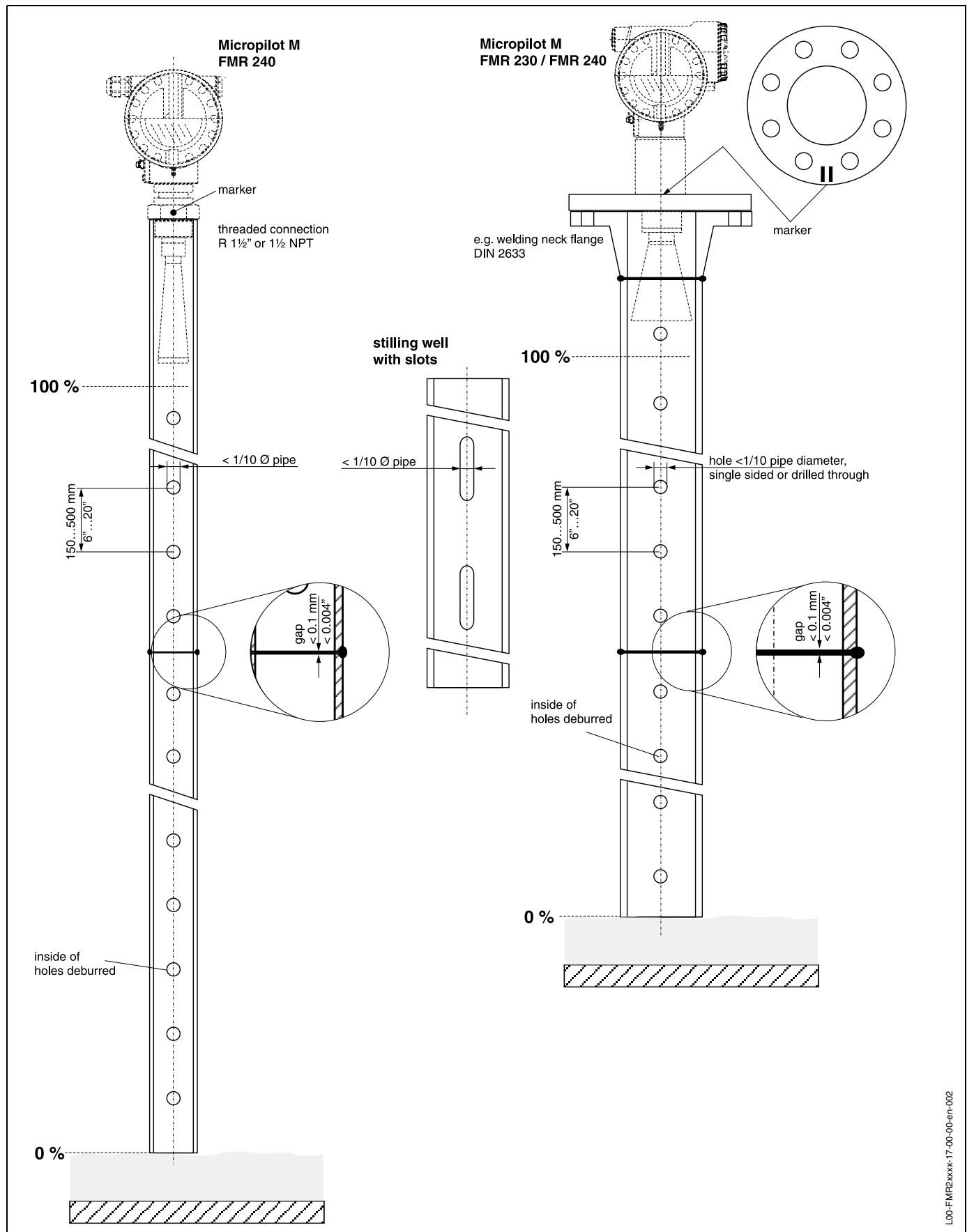
- Observe installation instructions on page 12.
- Marker is aligned toward slots.
- The marker is always exactly in the middle, between two bolt-holes in the flange.
- After mounting, the housing can be turned up to 350° in order to simplify access to the display and the terminal compartment.
- Measurements can be performed through a full bore open ball valve without any problems.

Recommendations for the stilling well

- Metal
- Constant diameter
- Weld seam as smooth as possible and on the same axis as the slots.
- Slots offset 180° (not 90°)
- Slot width (diameter of holes) should be max. 1/10 of pipe diameter, de-burred. Length and number do not have any influence on the measurement [suggested spacing 1 ft (30 cm) and 1" (2.5 cm) diameter. For light products, smaller diameter holes can be considered].
- Select horn antenna as big as possible. For intermediate sizes [i.e. 7" (180 mm)] select next larger antenna and adapt it mechanically.
- At any transition (i.e. when using a ball valve or mending pipe segments), no gap may be created exceeding 0.1 mm.
- The stilling well must be smooth on the inside [average roughness $R_z \leq 30 \mu\text{m}$ (0.03 mm)³]. Use extruded or parallel welded stainless steel pipe. An extension of the pipe is possible with welded flanges or pipe sleeves. Flange and pipe have to be properly aligned at the inside.
- Do not weld through the pipe wall. The inside of the stilling well must remain smooth. In case of unintentional welding through the pipe, the weld seam and any unevenness on the inside need to be carefully removed and smoothened. Otherwise, strong interference echoes will be generated and material build-up will be promoted.
- Particularly on smaller nominal widths, it needs to be observed that flanges are welded to the pipe such that they allow for a correct orientation (marker aligned toward slots).

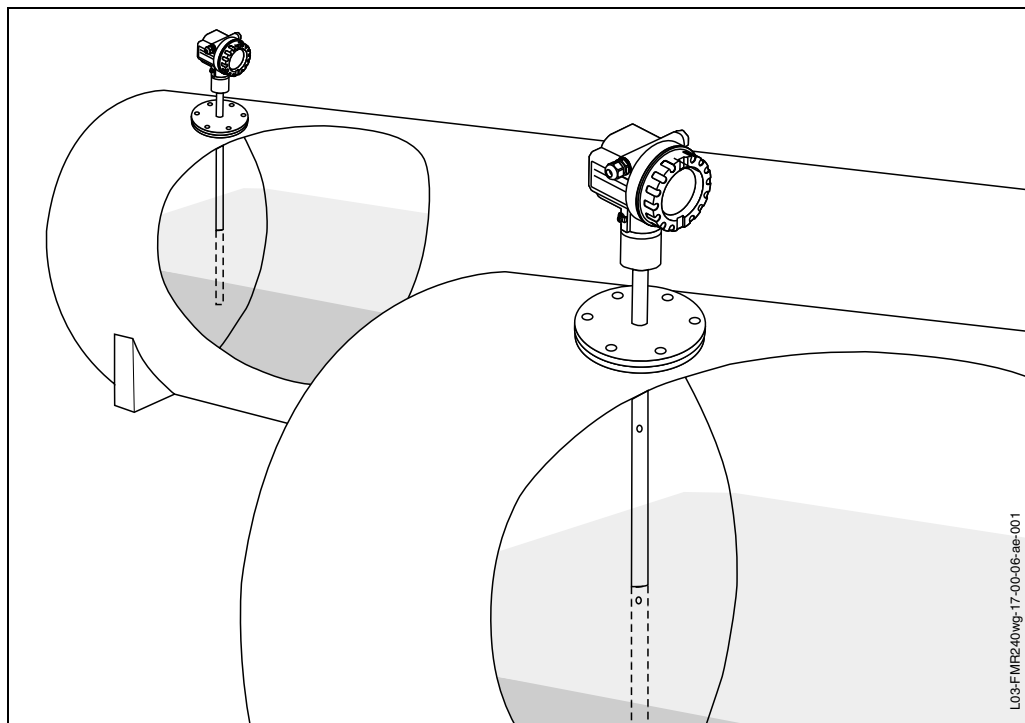
3) Average roughness (R_z) is the arithmetic average of 5 individually measured roughness values.

Examples for the construction of stilling wells



**Installation FMR 240
with wave guide antenna****Optimum mounting position**

FMR 240 wave guide
mounted on bullet tank

**Standard installation**

- Observe installation instructions on page 12.
- Can be mounted in a tank, bypass or slotted stilling well.
- No alignment is required.
- After mounting, the housing can be turned up to 350° in order to simplify access to the display and the terminal compartment.
- Only suitable for media with low viscosity, without the tendency for build-up in the wave guide antenna.

Operating conditions / Environment

Ambient temperature range	Ambient temperature for the transmitter: <ul style="list-style-type: none"> • For F12-housing: -40 °F ... +176 °F (-40 °C ... +80 °C) • For T12-housing: -40 °F ... +176 °F (-40 °C ... +80 °C)
Storage temperature	-40 °F ... +176°F (-40 °C ... +80 °C)
Climate class	DIN EN 60068-2-38 (test Z/AD)
Degree of protection	<ul style="list-style-type: none"> • Housing: IP 65, NEMA 4X (open housing: IP20, NEMA 1) • Antenna: IP 68 (NEMA 6P)
Vibration resistance	DIN EN 60068-2-64 / IEC 68-2-64: 20...2000 Hz, 1 (m/s ²) ² /Hz
Cleaning of the antenna	<p>The antenna may become contaminated, depending on the application or product. Thus, the emission and reception of microwaves can eventually degrade over time. The amount of contamination leading to an error depends on the product and the reflectivity, mainly determined by the dielectric constant. If the product tends to cause contamination and deposits, cleaning on a regular basis is recommended. Care should be taken not to damage the antenna during a mechanical or hose-down cleaning.</p> <p>Note! The material compatibility has to be considered if cleaning agents are used. The maximum permitted temperature at the flange should not be exceeded.</p>
Electromagnetic compatibility	<ul style="list-style-type: none"> • Emissions according to EN 61326; equipment class B • Compatibility according to EN 61326; appendix A (industrial area, 10 V/m) and Namur recommendation EMC (NE 21)

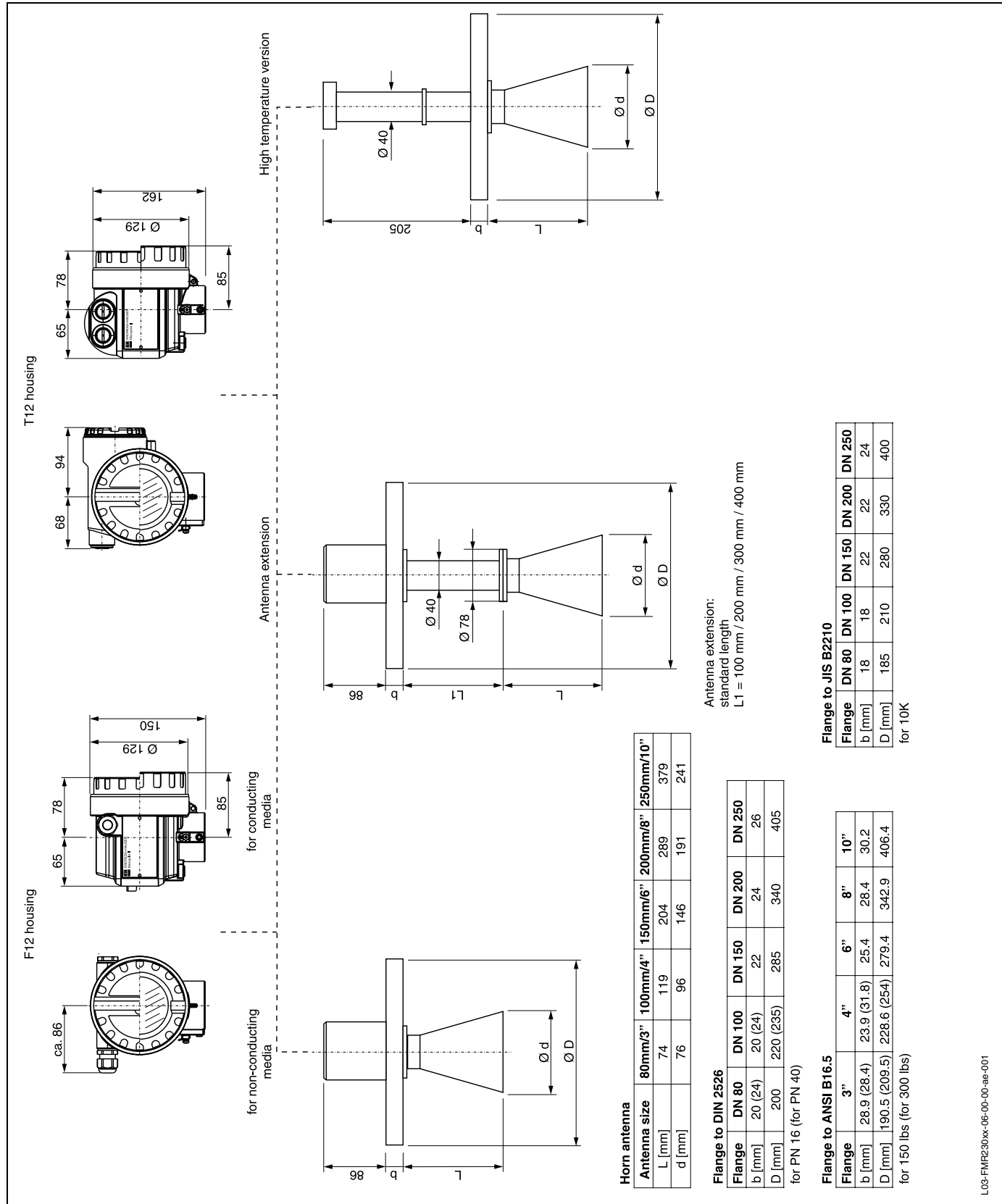
Operating conditions / Process

Process temperature range	See »Ordering information« on page 27 - 33.
Process temperature limits	See »Ordering information« on page 27 - 33.
Process pressure limits	See »Ordering information« on page 27 - 33.
Dielectric constant	<ul style="list-style-type: none"> • In a stilling well: $\epsilon_r \geq 1.4$ • In free space: $\epsilon_r \geq 1.9$

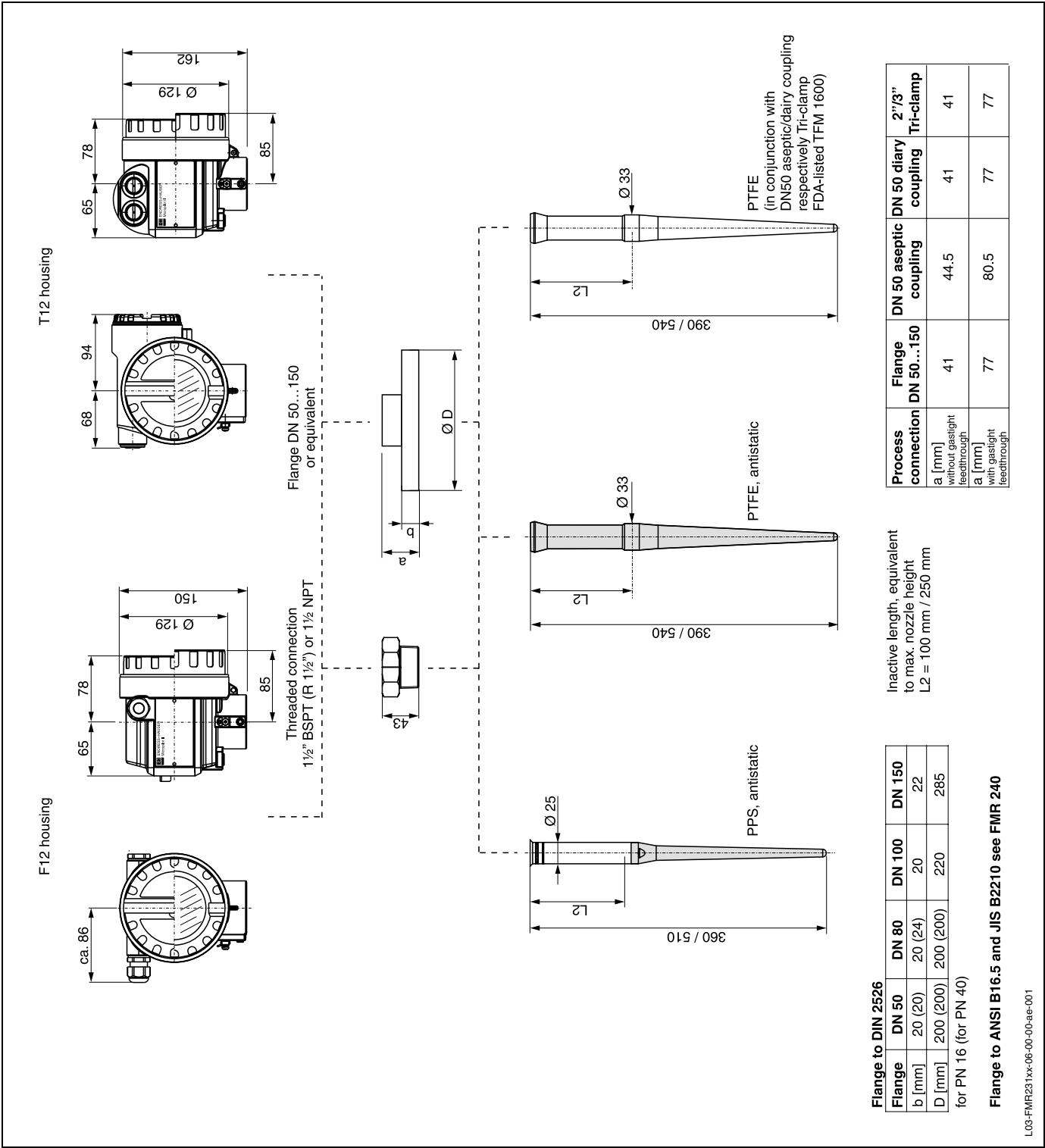
Mechanical construction

Design, dimensions

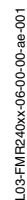
Micropilot M FMR 230



Micropilot M FMR 231



Endress+Hauser Systems & Gauging



Weight

Micropilot M	FMR 230	FMR 231	FMR 240
Weight	Approx. 13 lb (6 kg) + weight of flange	Approx. 9 lb (4 kg) + weight of flange	Approx. 9 lb (4 kg) + weight of flange

Housing

- Types of housings:
 - housing F12: with additionally sealed terminal compartment for standard or EEx ia
 - housing T12: separate terminal compartment for increased safety respectively explosion proof
- Material: aluminum, seawater repellent, chromate, powder coated
- Sight window: glass

Cable entry

M20x1.5; Pg 13.5 (gland included); ½ NPT; G ½ internal thread

Process connection

See »Ordering information« on page 27 - 33.

Seal

See »Ordering information« on page 27 - 33.

Antenna

See »Ordering information« on page 27 - 33.

Human interface

Operation concept

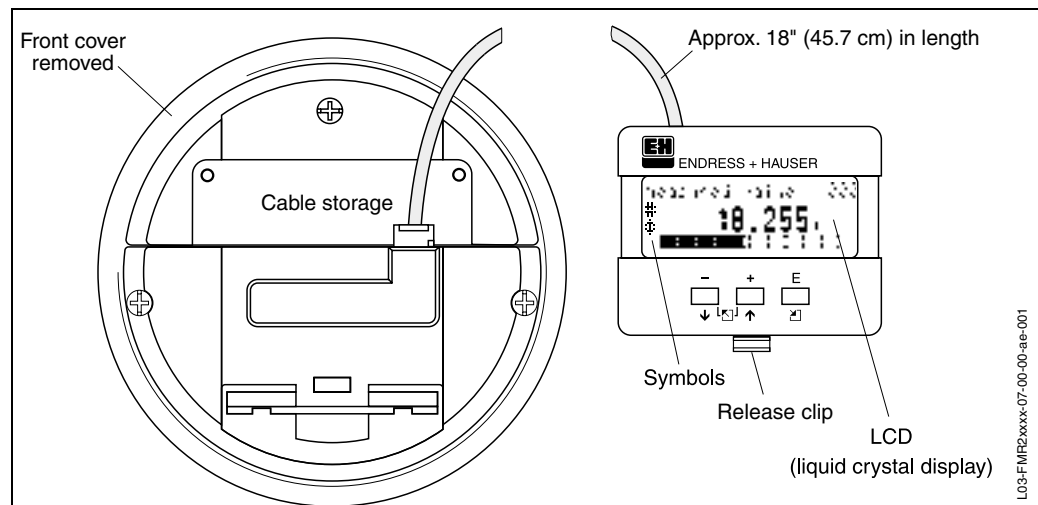
The display of the process value and the configuration of the Micropilot occur locally by means of a large 4-line alphanumeric display with plain text information. The guided menu system with integrated help texts ensures a quick and safe commissioning. Remote commissioning, including documentation of the measuring point and in-depth analysis functions, is supported via the ToF Tool, the graphical operating software for Endress+Hauser time-of-flight systems.

Display elements

Liquid crystal display (LCD):

Four lines with 20 characters each. Display contrast is adjustable through key combination.

Micropilot M display



Symbol on the display				
	continuously on	flashes on/off		
Meaning	alarm	warning	remote communication	locked

Operating elements













The operating elements are located inside the housing and are accessible for operation by unscrewing/removing the front cover of the housing.

On-site operation

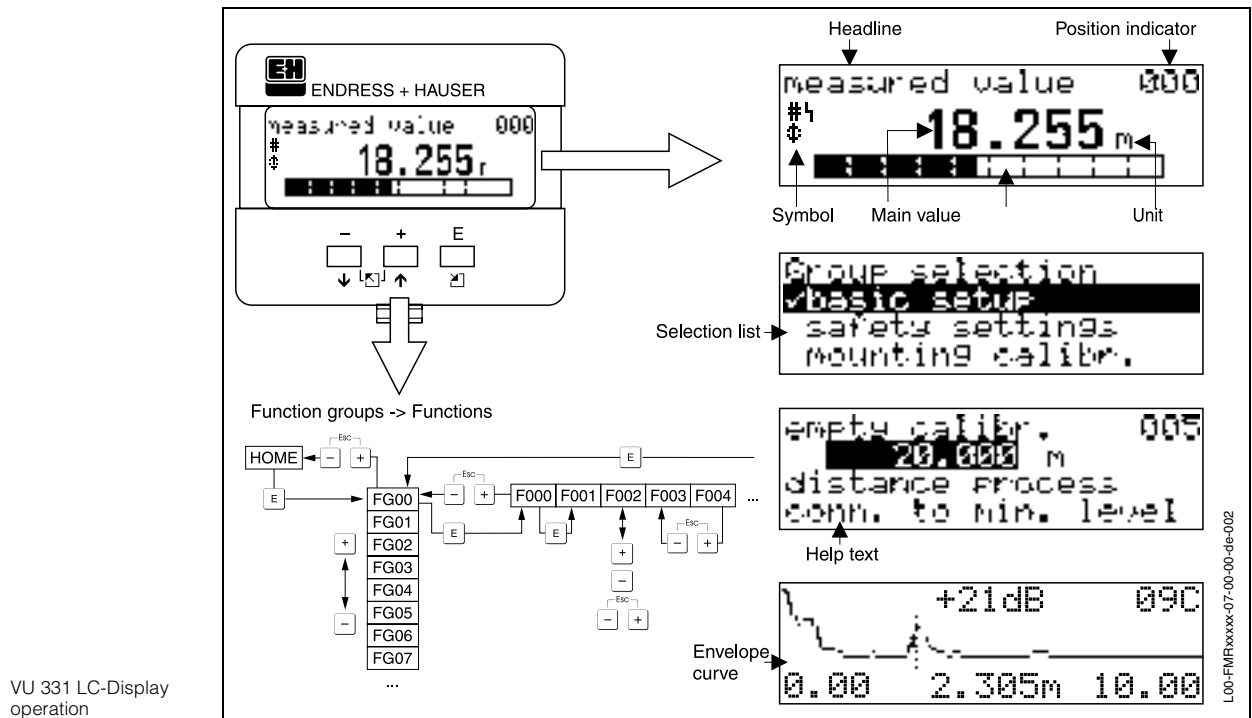
Operation with VU 331

The LC-Display VU 331 allows configuration via 3 keys directly at the instrument.

Function of the keys

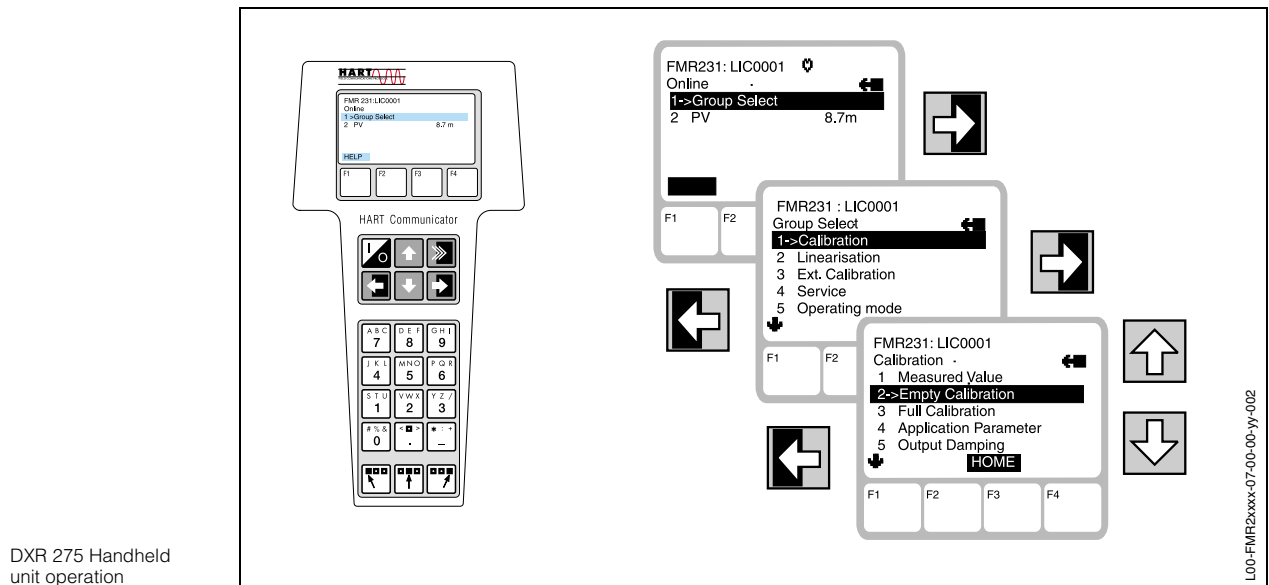
Key(s)	Meaning
 or 	Navigate upwards in the selection list Edit numeric value within a function
 or 	Navigate downwards in the selection list Edit numeric value within a function
 or 	Navigate to the left within a function group
 or 	Navigate to the right within a function group
 and  or  and 	Contrast settings of the LCD

All device functions can be set through a menu system. The menu consists of function groups and functions. Within a function, application parameters can be read or adjusted. The user is guided through a complete configuration procedure.



Operation with handheld unit DXR 275

All device functions can be adjusted via a menu operation with the handheld unit DXR 275.



Connection options:

- HART with Commubox FXA 191
- Service-interface with adapter FXA 193
- Via Tank Side Monitor NRF 590

Certificates and approvals

CE approval	The measuring system meets the legal requirements of the CE-guidelines. Endress+Hauser confirms the instrument passing the required tests by attaching the CE-mark.
RF approvals	R&TTE, FCC
Ex approval	See »Ordering information« on page 27 - 33.
Overspill protection	WHG (in preparation). See »Ordering information« on page 27 - 33.
External standards and guidelines	<p>EN 60529 Protection class of housing (IP-code)</p> <p>EN 61010 Safety regulations for electrical devices for measurement, control, regulation and laboratory use</p> <p>EN 61326 Emissions (equipment class B), compatibility (appendix A – industrial area)</p> <p>NAMUR Standards committee for measurement and control in the chemical industry</p>

Ordering information

Micropilot M FMR 230

Instrument selection




Certificate

Type of antenna / Seal


Communication

Housing



EEEx ia
IS



V,E,K




D



G




gastight

HART




F12



EEEx em / d
XP



V,E,K




D



G

gastight

HART



T12

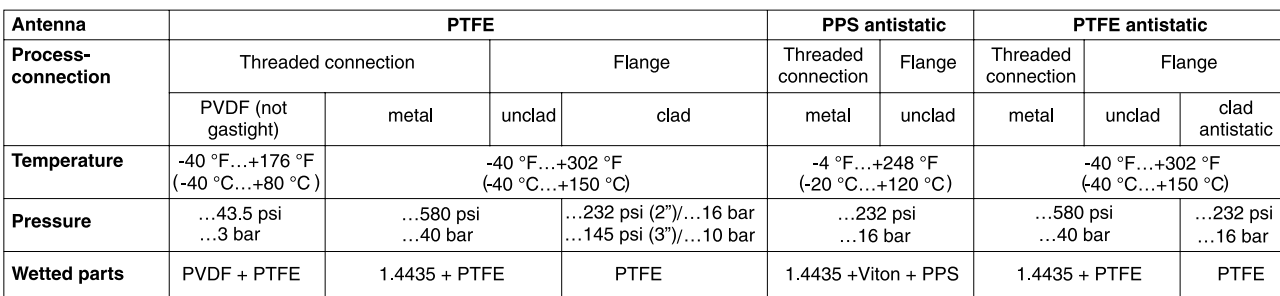
gastight = Standard

Type of antenna / Seal / Temperature	V Standard, Viton 4 °F...+392 °F (-20 °C...+200 °C) E Standard, EPDM -40 °F...+302 °F (-40 °C...+150 °C) K Standard, Kalrez 32 °F...+392 °F (0 °C...+200 °C)	D Standard, PTFE seal (non-wetted Viton O-Ring) -4 °F...+392 °F (-20 °C...+200 °C)	G High temperature, Graphit -76 °F...+752 °F (-60 °C...+400 °C)
Pressure	...928 psi (...64 bar)	...928 psi (...64 bar)	...1450 psi (...100 bar)
Media	for non-conductive media	for conductive media	
Antenna cone	PTFE	PTFE	Ceramic
Wetted parts	PTFE, seal and SS316Ti	PTFE and SS316Ti	Ceramic, Graphit and SS316Ti

L03-FMR230x-16-00-00-ae-001

10	Certificates																
	A	For non-hazardous areas															
	1	ATEX II 1/2 G	EEx ia IIC T6														
	2	ATEX II 1/2 G	EEx ia IIC T6, note safety instruction (XA) for electrostatic charging!														
	3	ATEX II 1/2 G	EEx em [ia] IIC T6														
	4	ATEX II 1/2 G	EEx d [ia] IIC T6														
	F	For non-hazardous areas + WHG															
	6	ATEX II 1/2 G	EEx ia IIC T6 + WHG														
	7	ATEX II 1/2 G	EEx ia IIC T6 + WHG, note safety instruction (XA) for electrostatic charging!														
	8	ATEX II 1/2 G	EEx em [ia] IIC T6 + WHG														
	S	FM	IS - Class I, Division 1, Group A-D														
	T	FM	XP - Class I, Division 1, Group A-D														
	U	CSA	IS - Class I, Division 1, Group A-D														
	V	CSA	XP - Class I, Division 1, Group A-D														
K	TIIS	EEx ia IIC T4															
Y	Special version																
<table><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>																	
FMR 230-								Product designation (part 1)									

20	Antenna size							
	2	3" / 80 mm						
	3	4" / 100 mm						
	4	6" / 150 mm						
	5	8" / 200 mm						
	6	10" / 250 mm						
30	Type of antenna, sealing, temperature							
		Type	Sealing	Temperature range				
	V	Standard	Viton/FKM	-4 °F...+392 °F / -20 °C...200 °C				
	E	Standard	EPDM	-40 °F...+302 °F / -40 °C...150 °C				
	K	Standard	Kalrez	32 °F...+392 °F / 0 °C...200 °C				
	D	Standard	PTFE	-4 °F...+392 °F / -20 °C...200 °C				
	G	High temperature	Graphit	-76 °F...+752 °F / -60 °C...400 °C				
Y	Special version							
40	Process connection, material							
		Flange Dia/Pressure	Standard	Material				
	CM2	DN80 PN16	DIN 2526 Form C	SS316Ti				
	CN2	DN80 PN40	DIN 2526 Form C	SS316Ti				
	CQ2	DN100 PN16	DIN 2526 Form C	SS316Ti				
	CR2	DN100 PN40	DIN 2526 Form C	SS316Ti				
	CW2	DN150 PN16	DIN 2526 Form C	SS316Ti				
	CX2	DN200 PN16	DIN 2526 Form C	SS316Ti				
	C62	DN250 PN16	DIN 2526 Form C	SS316Ti				
	EWT	DN150 PN16	DIN 2526 Form E	enamelled steel				
	EXT	DN200 PN16	DIN 2526 Form E	enamelled steel				
	CQ5	DN100 PN16	DIN 2526 Form C	Hastelloy C4 face				
	CW5	DN150 PN16	DIN 2526 Form C	Hastelloy C4 face				
	C65	DN250 PN16	DIN 2526 Form C	Hastelloy C4 face				
	AL2	3"/150 lbs	ANSI B16.5	SS316Ti				
	AM2	3"/300 lbs	ANSI B16.5	SS316Ti				
	AP2	4"/150 lbs	ANSI B16.5	SS316Ti				
	AQ2	4"/300 lbs	ANSI B16.5	SS316Ti				
	AV2	6"/150 lbs	ANSI B16.5	SS316Ti				
	A32	8"/150 lbs	ANSI B16.5	SS316Ti				
	A52	10"/150 lbs	ANSI B16.5	SS316Ti				
	AVT	6"/150 lbs	ANSI B16.5	enamelled steel				
	A3T	8"/150 lbs	ANSI B16.5	enamelled steel				
	AV5	6"/150 lbs	ANSI B16.5	Hastelloy C4 face				
	A35	8"/150 lbs	ANSI B16.5	Hastelloy C4 face				
	A55	10"/150 lbs	ANSI B16.5	Hastelloy C4 face				
	KA2	10 K 80	JIS B2210	SS316Ti				
	KH2	10 K 100	JIS B2210	SS316Ti				
	KV2	10 K 150	JIS B2210	SS316Ti				
	KD2	10 K 200	JIS B2210	SS316Ti				
	K52	10 K 250	JIS B2210	SS316Ti				
	YY9	Special version						
50	Output and menu based operation							
	A	4...20 mA HART with VU 331 (4-line alphanumeric display)						
	B	4...20 mA HART						
	Y	Special version						
60	Housing							
	A	Aluminum F12-housing, coated, IP65						
	C	Aluminum T12-housing with separate connection compartment, coated, IP65						
	Y	Special version						
70	Gland / Entry							
	1	Pg13.5 cable gland						
	2	M20x1.5 cable gland						
	3	G ½ cable entry						
	4	½ NPT cable entry						
	9	Special version						
80	Additional options							
	A	Additional options not selected						
	B	3.1.B material, wetted parts SS316Ti, Inspection Certificate EN 10204, acc. specification 52005759						
FMR 230-								Complete product designation



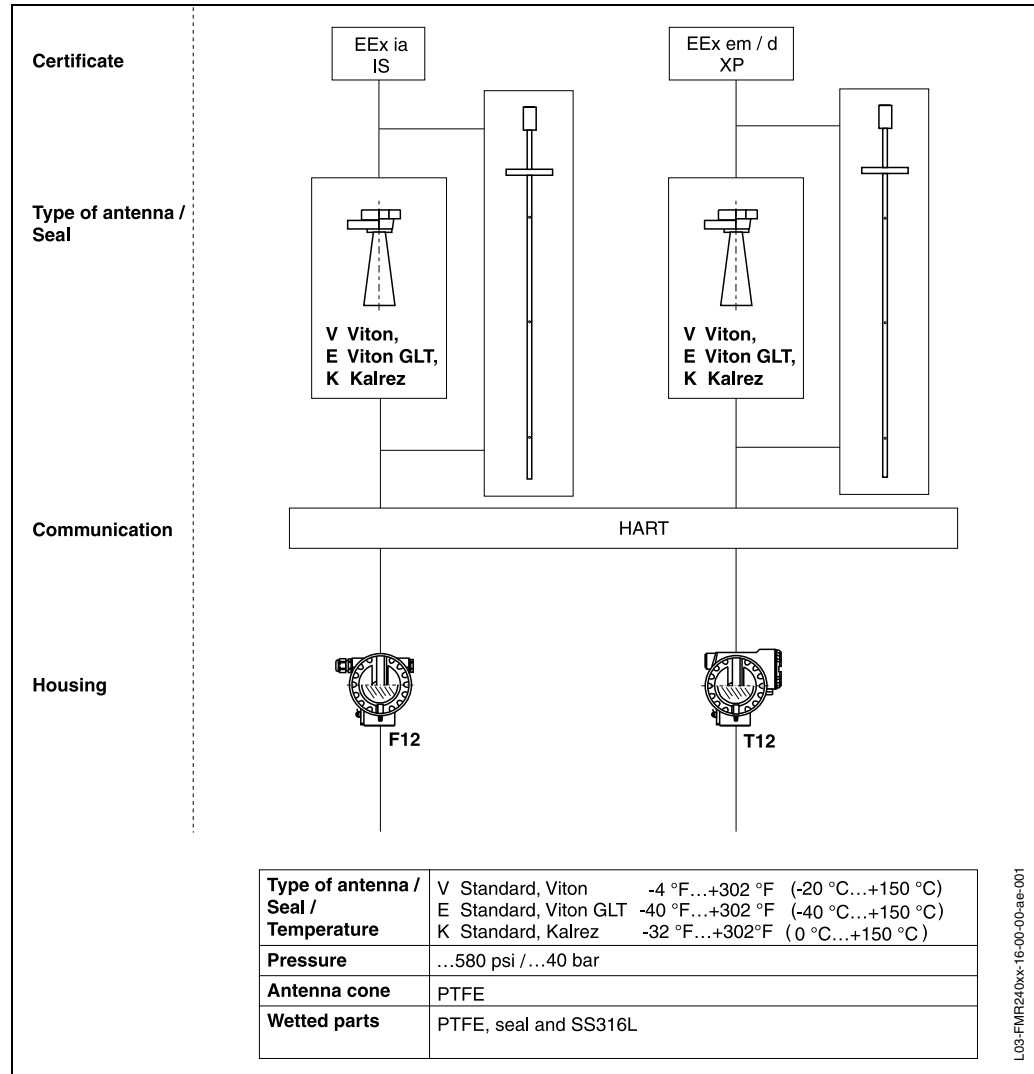
03-FMR231xx-16-00-00-ae-001

29

31

Micropilot M FMR 240

Instrument selection



10	Certificates							
A		For non-hazardous areas						
1		ATEX II 1/2 G EEx ia IIC T6						
3		ATEX II 1/2 G EEx em [ia] IIC T6						
4		ATEX II 1/2 G EEx d [ia] IIC T6						
F		For non-hazardous areas + WHG						
6		ATEX II 1/2 G EEx ia IIC T6 + WHG						
8		ATEX II 1/2 G EEx em [ia] IIC T6 + WHG						
S		FM IS - Class I, Division 1, Group A-D						
T		FM XP - Class I, Division 1, Group A-D						
U		CSA IS - Class I, Division 1, Group A-D						
V		CSA XP - Class I, Division 1, Group A-D						
K		TIIS EEx ia IIC T4						
Y		Special version						
20	Antenna size							
2		1 ½" / 40 mm						
3		2" / 50 mm						
4		3" / 80 mm						
5		4" / 100 mm						
7		mm Wave Guide antenna, inside diameter: 21 mm						
8		inch Wave Guide antenna, inside diameter: 21 mm						
FMR 240-								
Product designation (part 1)								

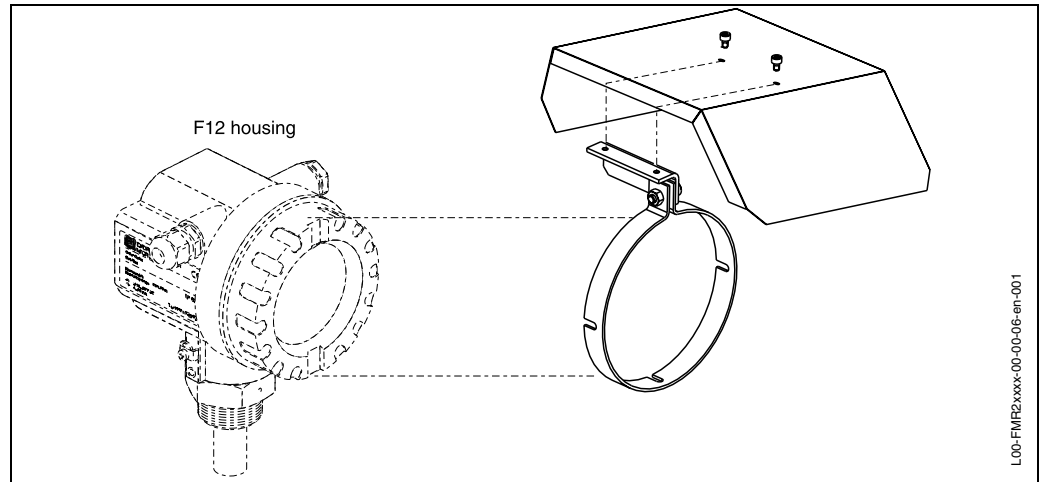
30					Type of antenna, sealing, temperature			
					Type	Sealing	Temperature range	
	V				Standard	Viton/FKM	-4 °F...+302 °F / -20° C...150° C	
	E				Standard	Viton GLT	-40 °F...+302 °F / -40° C...150° C	
				K	Standard	Kalrez	32 °F...+302 °F / 0° C...150° C	
40					Antenna extension			
					1	without antenna extension		
					2	4" / 100 mm antenna extension		
					9	Special length		
50					Process connection, material			
						Threaded connection	Material	
					GNJ	NPT 1½"	SS316L	
					GGJ	1½" BSPT (R 1½", DIN 2999)	SS316L	
					Flange Dia/Pressure	Standard	Material	
					CFJ	DN50 PN16	DIN 2526 Form C	SS316L
					CGJ	DN50 PN40	DIN 2526 Form C	SS316L
					CMJ	DN80 PN16	DIN 2526 Form C	SS316L
					CNJ	DN80 PN40	DIN 2526 Form C	SS316L
					CQJ	DN100 PN16	DIN 2526 Form C	SS316L
					CRJ	DN100 PN40	DIN 2526 Form C	SS316L
					CWJ	DN150 PN16	DIN 2526 Form C	SS316L
					AEJ	2"/150 lbs	ANSI B16.5	SS316L
					AFJ	2"/300 lbs	ANSI B16.5	SS316L
					ALJ	3"/150 lbs	ANSI B16.5	SS316L
					AMJ	3"/300 lbs	ANSI B16.5	SS316L
					APJ	4"/150 lbs	ANSI B16.5	SS316L
					AQJ	4"/300 lbs	ANSI B16.5	SS316L
					AWJ	6"/150 lbs	ANSI B16.5	SS316L
					KEJ	10 K 50A	JIS B2210	SS316L
					KLJ	10 K 80A	JIS B2210	SS316L
					KPJ	10 K 100A	JIS B2210	SS316L
					KWJ	10 K 150A	JIS B2210	SS316L
					YY9	Special version		
60						Output and menu based operation		
					A	4...20 mA HART with VU 331 (4-line alphanumeric display)		
					B	4...20 mA HART		
					Y	Special version		
70						Housing		
					A	Aluminium F12-housing, coated, IP65		
					C	Aluminium T12-housing with separate connection compartment, coated, IP65		
					Y	Special version		
80						Gland / Entry		
					1	Pg13.5 cable gland		
					2	M20x1.5 cable gland		
					3	G ½ cable entry		
					4	½ NPT cable entry		
					9	Special version		
90						Additional options		
					A	Additional options not selected		
					B	3.1.B material, wetted parts SS316L, Inspection Certificate EN 10204, acc. specification 52005759		
						Complete product designation		
FMR 240-						Complete product designation		

Accessories

Protective cover

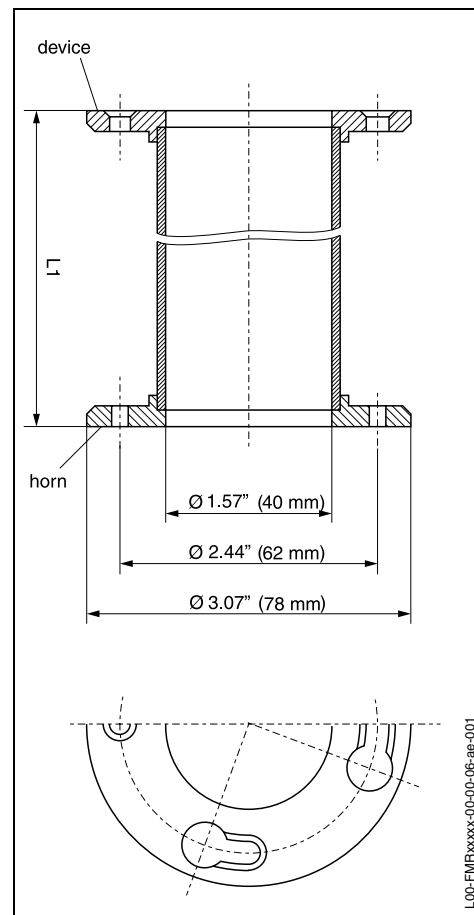
A protective cover made of stainless steel is available for additional protection (order code: 543199-0001). The shipment includes the protective cover and tension clamp.

Protective cover
placement on
Micropilot M



Antenna extension FAR 10 (for FMR 230)

Dimensions



FMR 230 antenna
extension

Ordering information

10	Material
2	1.4571
4	2.4600/Hastelloy B3
5	2.4610/Hastelloy C4
9	Special material
80	Overall length L1
A	4' / 100 mm
B	8' / 200 mm
C	12' / 300 mm
D	16' / 400 mm
Y	Special length
FAR 10-	Complete product designation

Commubox FXA 191

For intrinsically safe communication with ToF Tool or Commuwin II via the RS 232C-interface

Service adapter FXA 193

For communication with ToF Tool via the display connector

Documentation

System information	SI 039G/03/ae System information for Tank Side Monitor NRF 590
Technical Information	TI 039G/03/ae Technical information for Tank Side Monitor NRF 590
Operating instructions	BA 218F/00/en Operating instructions for Micropilot M FMR 230 (HART) BA 219F/00/en Operating instructions for Micropilot M FMR 231 (HART) BA 220F/00/en Operating instructions for Micropilot M FMR 240 (HART) KA 159F/00/a2 Short manual (quick reference) in housing (HART)
Certificates	XA 099F-A Installation Micropilot M FMR 2xx (F12 / EEx ia IIC T6) PTB 00 ATEX 2118, Equipment marking: (II 1/2 G) XA 100F-A Installation Micropilot M FMR 2xx (T12 / EEx em [ia] IIC T6) PTB 00 ATEX 2118, Equipment marking: (II 1/2 G) XA 101F-A Installation Micropilot M FMR 2xx (T12 / EEx d [ia] IIC T6) PTB 00 ATEX 2118, Equipment marking: (II 1/2 G) XA 103F-A Installation Micropilot M FMR 2xx (F12 / EEx ia IIC T6) PTB 00 ATEX 2117 X, Equipment marking: (II 1/2 G) XA 104F-A Installation Micropilot M FMR 2xx (T12 / EEx em [ia] IIC T6) PTB 00 ATEX 2117 X, Equipment marking: (II 1/2 G) XA 105F-A Installation Micropilot M FMR 2xx (T12 / EEx d [ia] IIC T6) PTB 00 ATEX 2117 X, Equipment marking: (II 1/2 G) ZD 055F/00 Control drawing Micropilot M FMR 2xx HART FM, IS (F12 / Ex ia IIC) ZD 058F/00 Control drawing Micropilot M FMR 2xx HART FM, XP-IS (T12 / Ex d [ia] IIC) ZD 059F/00 Control drawing Micropilot M FMR 2xx HART CSA, IS (F12 / Ex ia IIC)

ZD 062F/00

Control drawing Micropilot M FMR 2xx HART
CSA, XP-IS (T12 / Ex d [ia] IIC)

This product may be protected by at least one of the following listed patents.
Further patents are pending.

- US 5,387,918 i EP 0 535 196
- US 5,689,265 i EP 0 626 063
- US 5,659,321
- US 5,614,911 i EP 0 670 048
- US 5,594,449 i EP 0 676 037
- US 6,047,598
- US 5,880,698
- US 5,926,152
- US 5,969,666
- US 5,948,979
- US 6,054,946
- US 6,087,978
- US 6,014,100

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Endress + Hauser
Systems & Gauging

